SESAME Synchrotron Light Source

Girder System Mechanical Design

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ABSTRACT:
SESAME is a 2.5GeV, 3rd Generation Synchrotron Light Source currently under construction at Allan area 20 km from Amman the capital of Jordan. One of the major players on beam stability is the girder magnet system vibration stability. The design of the girder system will compromise the ease of alignment and installation of the Arc vacuum chamber. as the dipole magnet is a C shape magnet with an iron length of 2208mm, and the Arc vacuum includes 1447mm and 1545mm of the straight upstream and downstream respectively which is welded to the arced part of the chamber, a special moving mechanism has been adapted to move the dipole magnet on the girder in order to facilitate the installation of the chamber. This paper describes the design of the girder system including the different static simulation during installation process will as the vibration simulation analysis.

Introduction

SESAME project have faced many challenges and constraints through its constriction journey.. Due to the limited number of technical team in the mechanical design group and the large number of design and development projects we decided to go to an existing design solution which could be applicable to fit for the SESAME case . Many existed girder designs have been explored and analyzed and for our case we have chose to adapt the design concept of ALBA girder system with some modifications in order to fit to SESAME machine considerations. The current Design of sesame girder system compromise the easy of installation and adjustment with the relatively high Eigen frequency .

SESAME Storage Ring Girder System Description

The girder system of SESAME consists of one type of girders which will hold one bending magnet , two long quads, two short quads and four sextuples. 16 girders are required for storage ring . The overall weight of SESAME magnets on one girder is 8.8 tons, the girder system weighs, 4 tones . in our case the weight of the girder and magnets exceeds the crane capacity . This means that the installation process should be divided into stages: Starting from the installation of the girder system with a rough alignment then the installation of the magnets on its final position except for the dipole magnet. Since we have a C shape magnet the dipole should be displaced from the final position in the horizontal transverse direction in order to install the Arch vacuum chamber .

The girder system top plate will have the alignment reference pins for the magnets . When the magnets placed on the girder on its final position it will be touching the alignment reference pins. Since the magnets will be shimmed after the magnetic measurement of the magnets and also after alignment reference pins positions on the girder, the shims will compensate for the misalignment between the mechanical and magnetic center of the magnets and the error in the position of the alignment pins

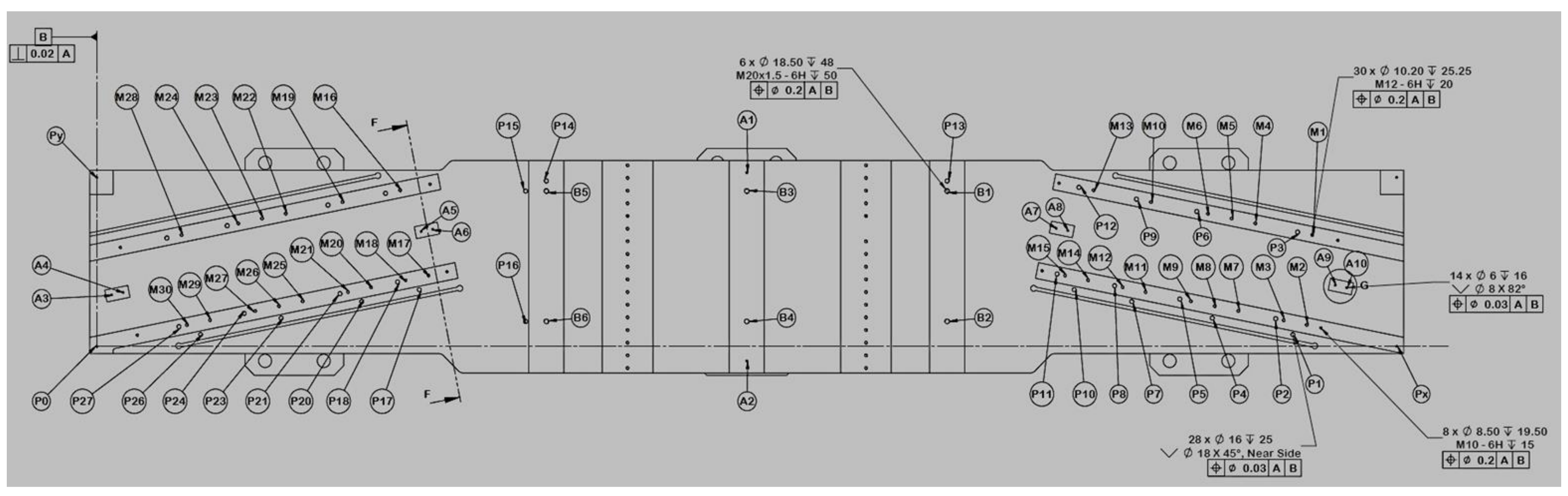

Fig.1: Girder Top Plate surface

After the placement of the magnets on the girder top plate the only required alignment is the girder to girder alignment . Which will be accomplished through the vertical, transverse and longitudinal alignment wedges placed between the girder top plate and the girder pedestals. On the vertical direction alignment wedges with stiff ball – to plate contact point on three locations , for the transverse and longitudinal alignment of the girder alignment horizontal and longitudinal wedges will be used .

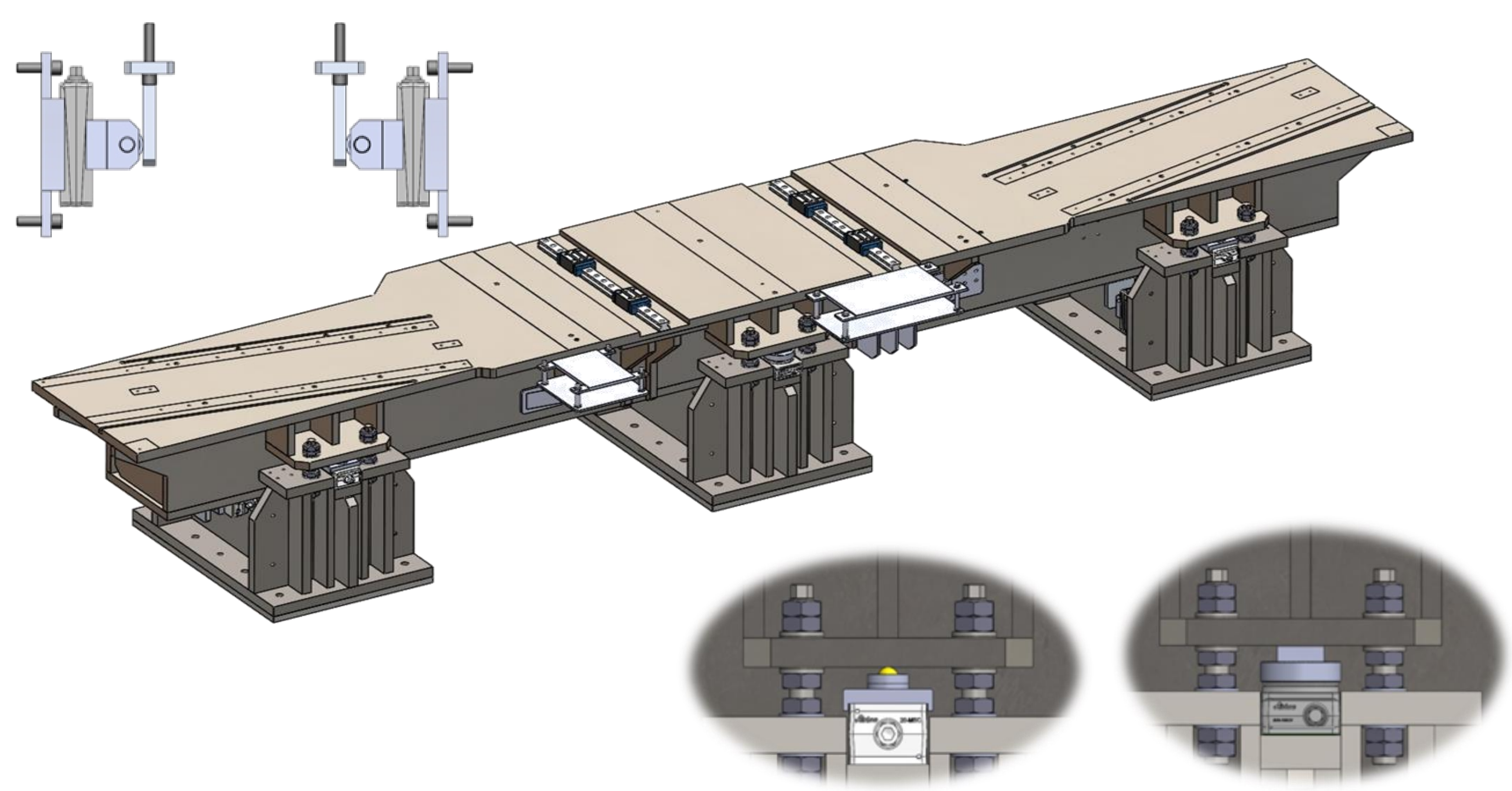

Fig.2: Girder System , Adjustment Mechanism

Girder Simulation

Several design alternatives have been figured out as a proposal for the SESAME girder system design. Simulations have been conducted on ANKA , Alba and SOLEIL design. finally as mentioned before we have adapted the design concept of Alba with some modifications to the pedestal design and the girder to girder adjustment mechanisms.

Static, Modal and PSD analysis using PSD measurement of other existing synchrotron light facilities have been conducted.

Static Analysis

Static analysis have been performed for the girder-magnets system , two major cases have been studied: the first case was the final position of the dipole magnet, the second case was the displaced dipole case in which the dipole magnet will be displaced during the vacuum chamber installation. As shown in the figures bellow the maximum deformation for the dipole final position is 37 microns while the deformation for the displaced dipole case was 57 microns.

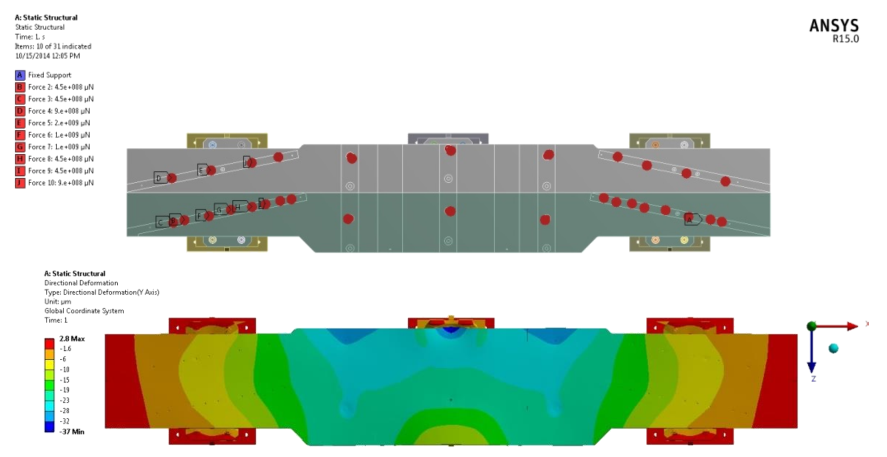

Figure 3.1:Girder Deformation Y Direction, Dipole Final Position

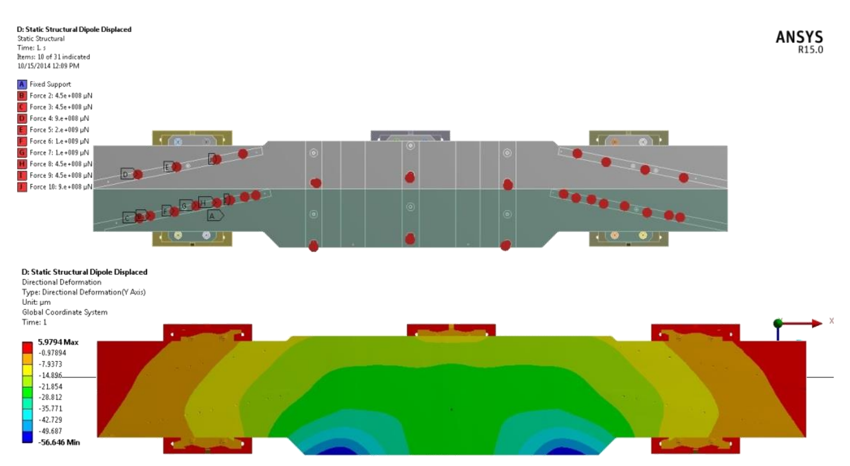

Figure 3.2:Girder Deformation Y Direction ,Dipole Displaced Position

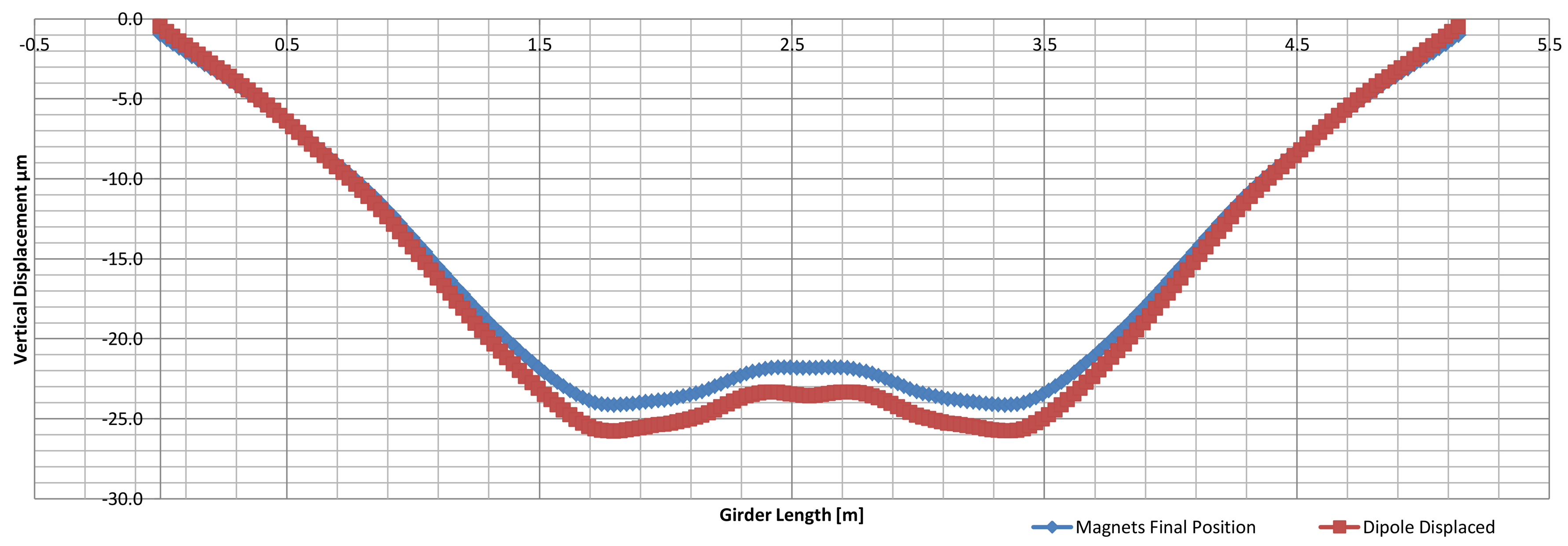

Figure 4:Girder Pad Bottom Plate Deformation Y Direction

Modal Analysis:

Modal Analysis for the current SESAME girder system design using ANSYS workbench15 finite element analysis software in which over 20 modes have been extracted. Shown in figure 4 the mode shape for the firs 10 modes the lowest natural frequency was 24 HZ , the first two natural frequencies was on the range of 24 Hz and the shape of the first two modes is an in phase and out phase rotation of the short quad. Magnet , the 3rd to 6th modes is on the 27 Hz rang and the shape is a rotation about Z Axis for the Sextupole magnets , the 7th mode frequency is 45 Hz and the shape is dipole rotation around X axis , the girder Pad

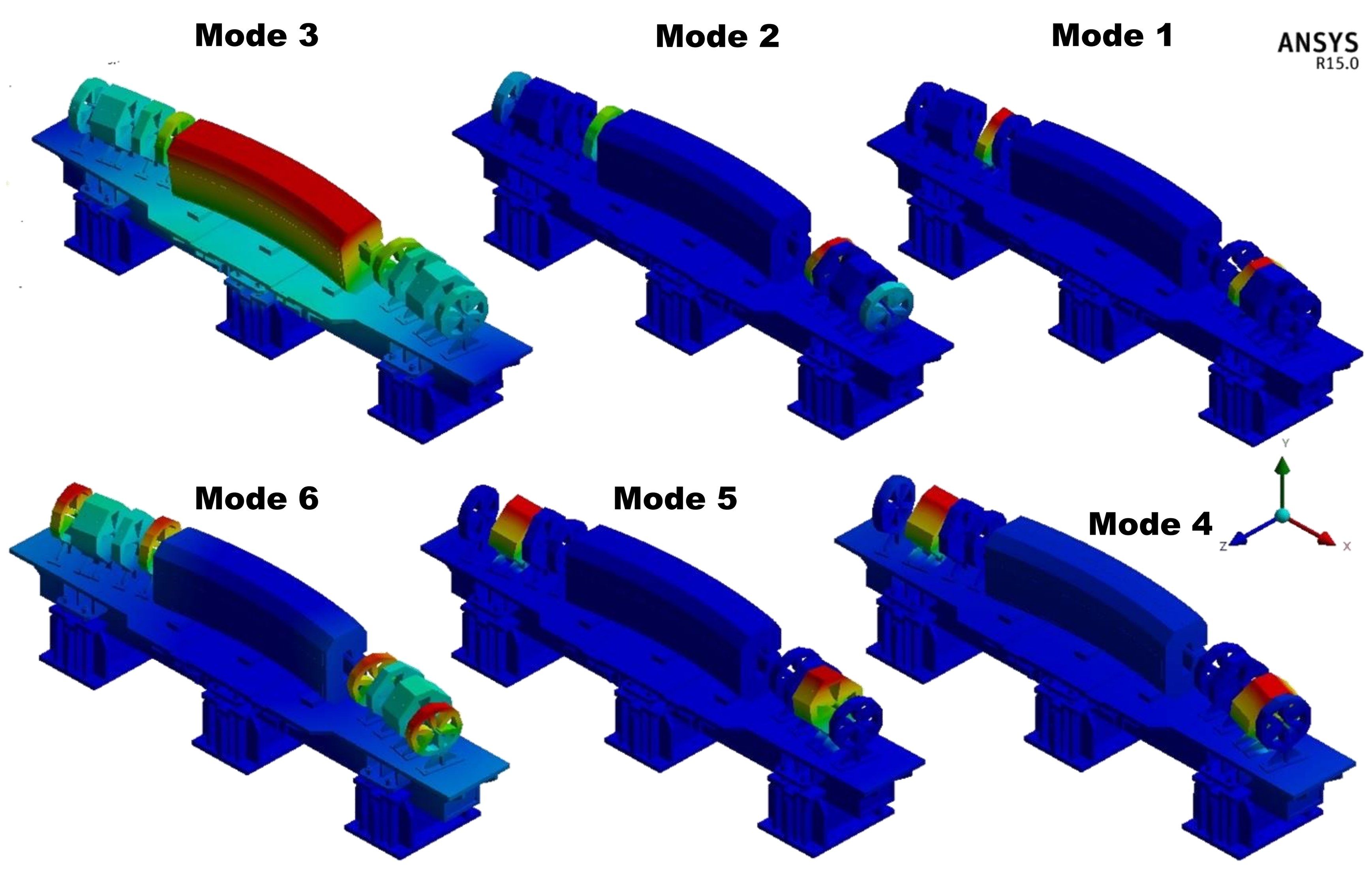

Figure5: the first 10 mode shapes of the Girder – Magnets Assembly

Table 1: The first 10 Natural Frequencies of the Girder – Magnets Assembly

Mode No.	Frequency	Shape
1	24.291	Short Quads Rotation Z Axis
2	27.393	Sextuples Rotation Z Axis
3	45.421	Dipole Rotation X Axis
4	62.791	Long Quad Rotation Z Axis
5	65.543	Long Quad Rotation Z Axis
6	70.297	Multipoles Rotation X Axis

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